SMART GRID INTEROPERABILITY PANEL

SPRING 2012 FACE-TO-FACE
CHARLOTTE, NC

# CUSTOMER-SITE INFORMATION SUPPORT FOR TRANSMISSION AND DISTRIBUTION OPERATIONS

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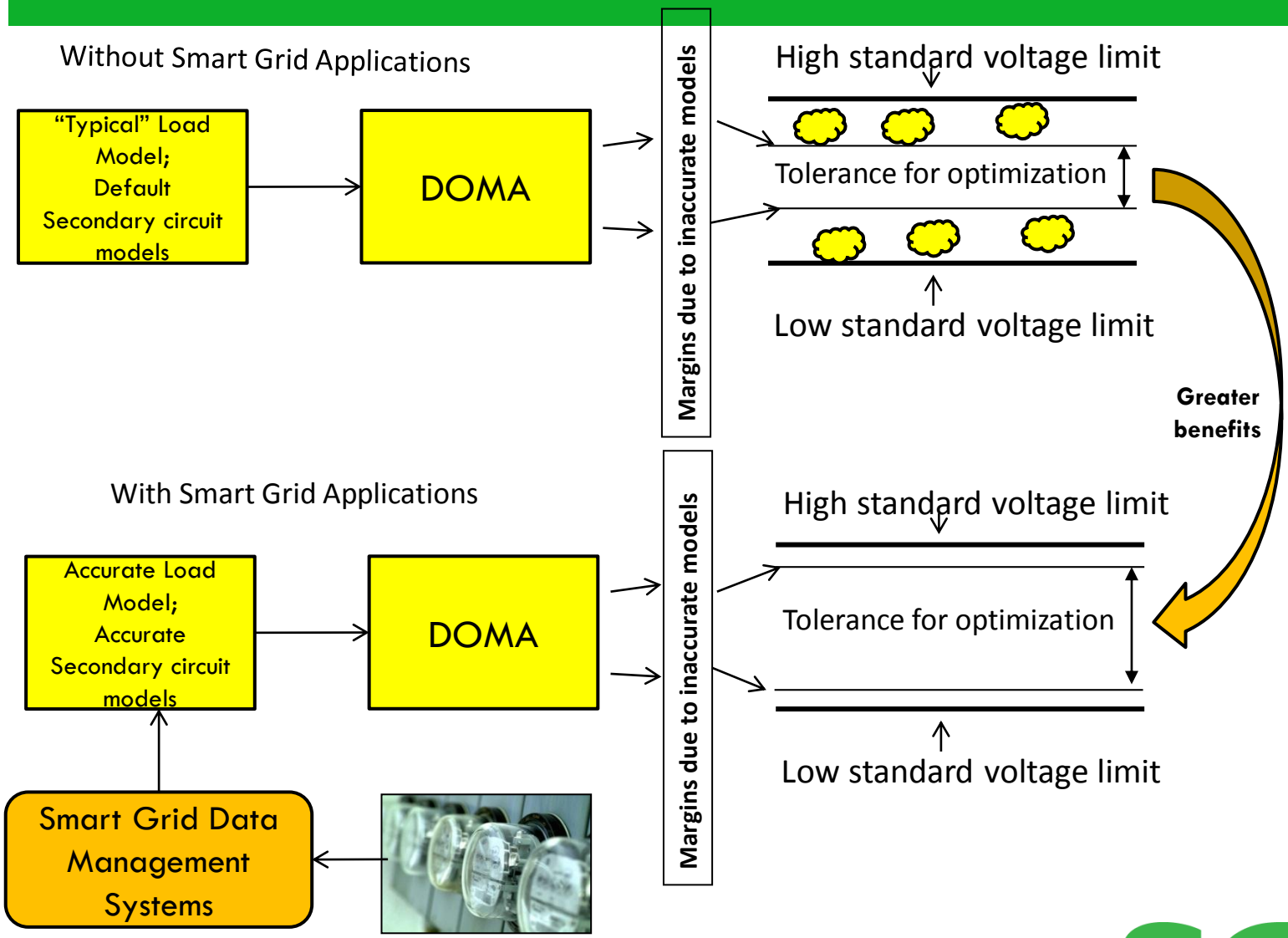
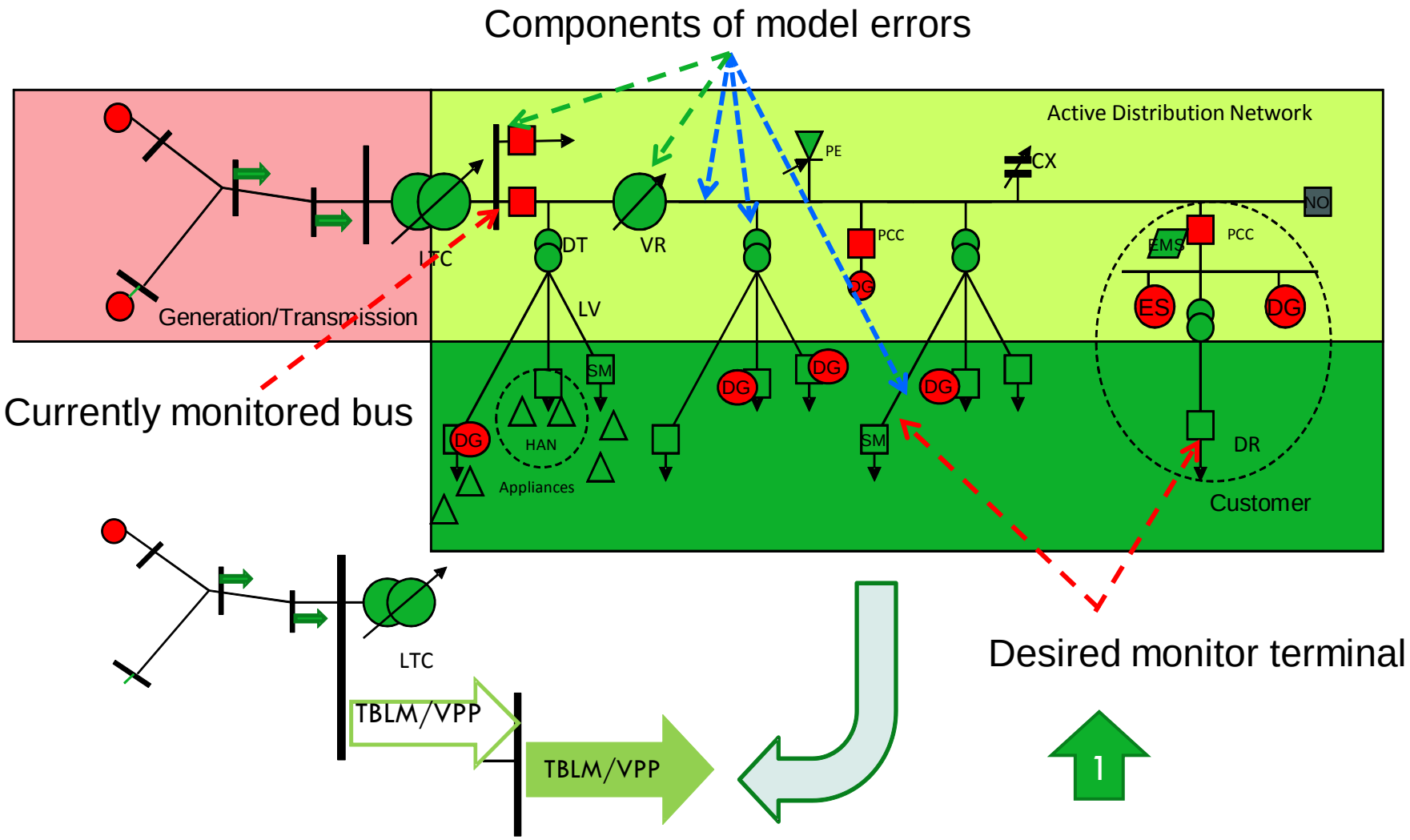
# Introduction

- Advanced Distribution Automation applications are based on near real-time computer-aided models of distribution operations
- The models for advanced DA applications must reflect not only the current state of the object but also support the look-ahead states dependent on changing conditions. Hence the models shall be **predictive and adaptable**.
- The fundamental model for the advanced DA applications is the power flow/state estimation model down to the equivalents of the low voltage circuits. 1
- The critical results of the power flow are the loading of the circuit elements and **the voltages at the designated buses, predominantly at the customer terminals.**

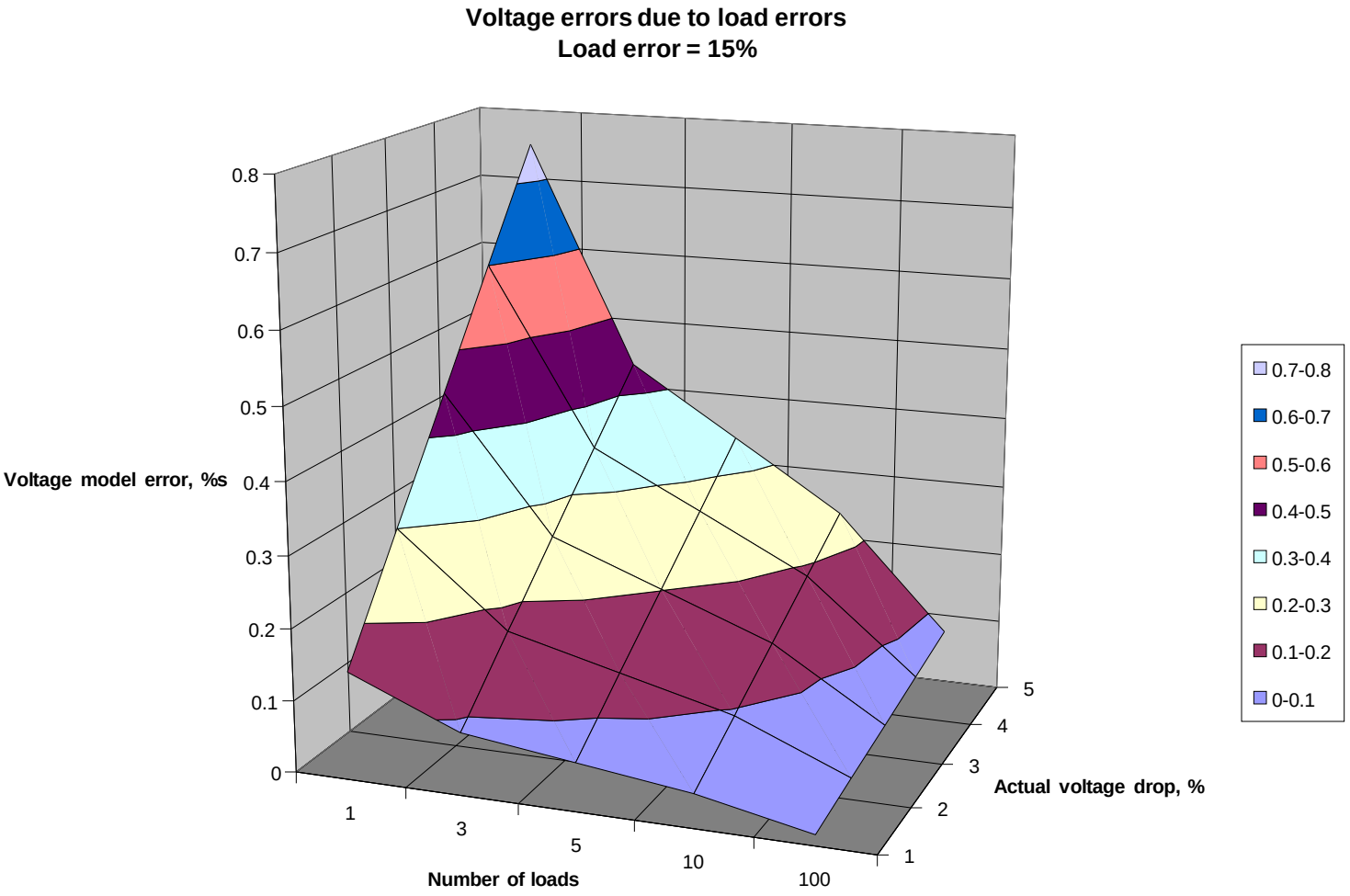
# Impact of Accuracy of Models on Operations Benefits



# Background components of TnD Object/Data Models



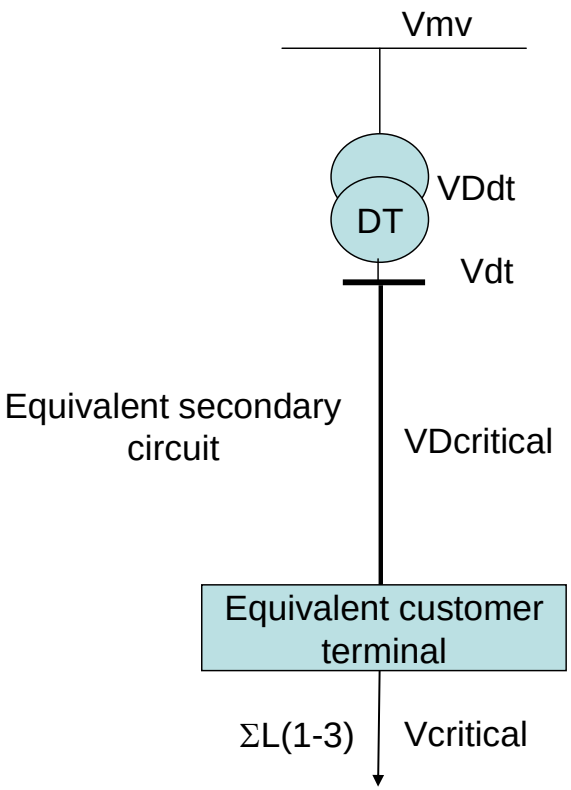
# In the most loaded segments the errors in the voltage drop calculated by DSE do not exceed 0.1% of nominal voltage



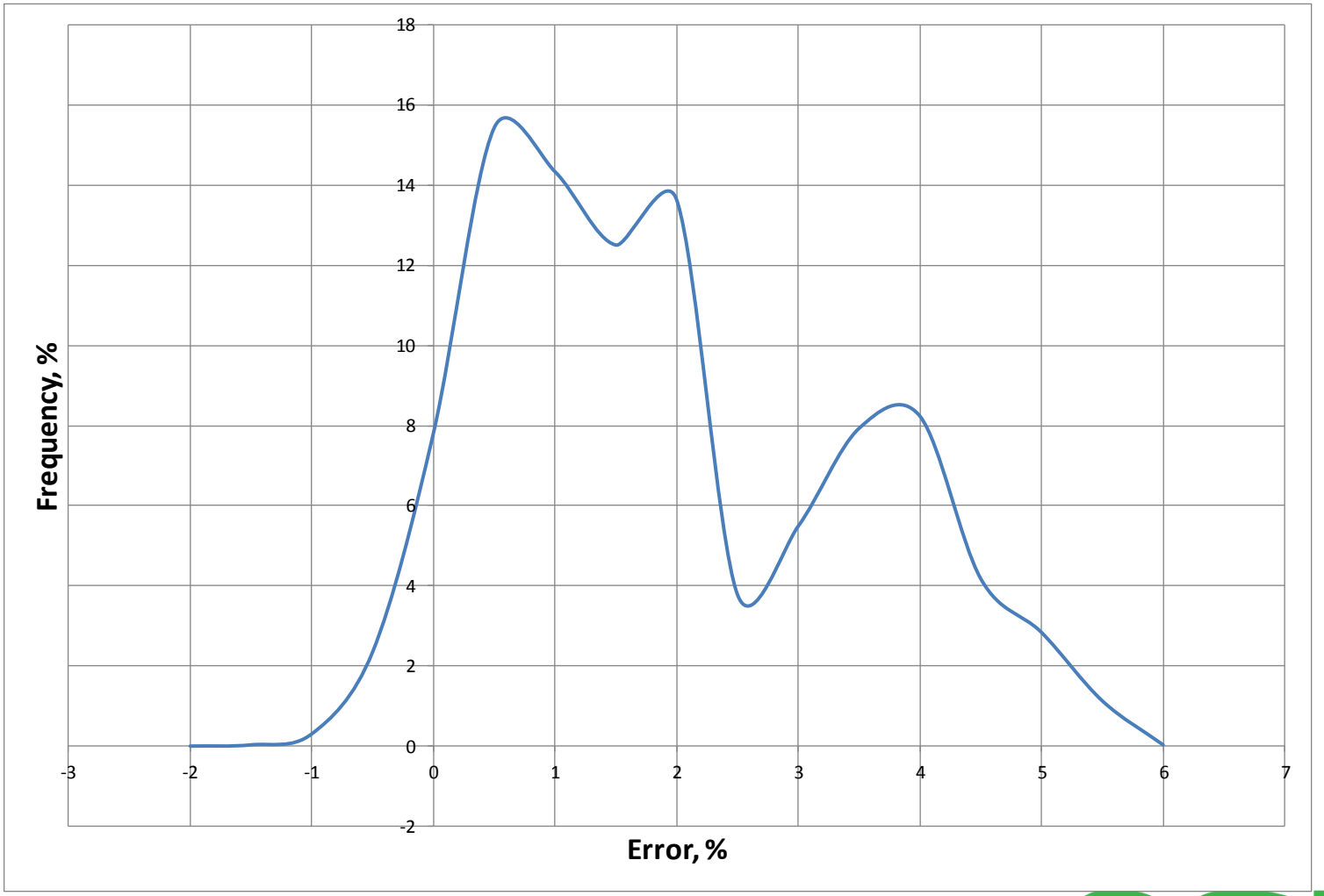
# Voltage Drop Error in Three-phase Distribution Transformer Vs Load Model Accuracy

| | | kvar errors, p.u. of kVA | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -0.25 | -0.2 | -0.15 | -0.1 | -0.05 | 0 | 0.05 | 0.1 | 0.15 | 0.2 | 0.25 |
| kW errors, p.u. kVA | -0.25 | | | | | -0.43 | -0.20 | 0.02 | 0.25 | 0.476 | | |
| | -0.2 | | | | | -0.39 | -0.16 | 0.07 | 0.29 | | | |
| | -0.15 | | | | | -0.35 | -0.12 | 0.11 | 0.34 | | | |
| | -0.1 | | | | | -0.31 | -0.08 | 0.15 | 0.38 | | | |
| | -0.05 | | | | -0.50 | -0.27 | -0.04 | 0.19 | 0.42 | | | |
| | 0 | | | | -0.46 | -0.23 | 0.00 | 0.23 | 0.46 | | | |
| | 0.05 | | | | -0.42 | -0.19 | 0.04 | 0.27 | 0.50 | | | |
| | 0.1 | | | | -0.39 | -0.15 | 0.08 | 0.31 | | | | |
| | 0.15 | | | | -0.35 | -0.12 | 0.12 | 0.35 | | | | |
| | 0.2 | | | | -0.31 | -0.08 | 0.15 | 0.39 | | | | |
| | 0.25 | | | | -0.28 | -0.04 | 0.19 | 0.42 | | | | |

# Equivalent Secondary Circuit



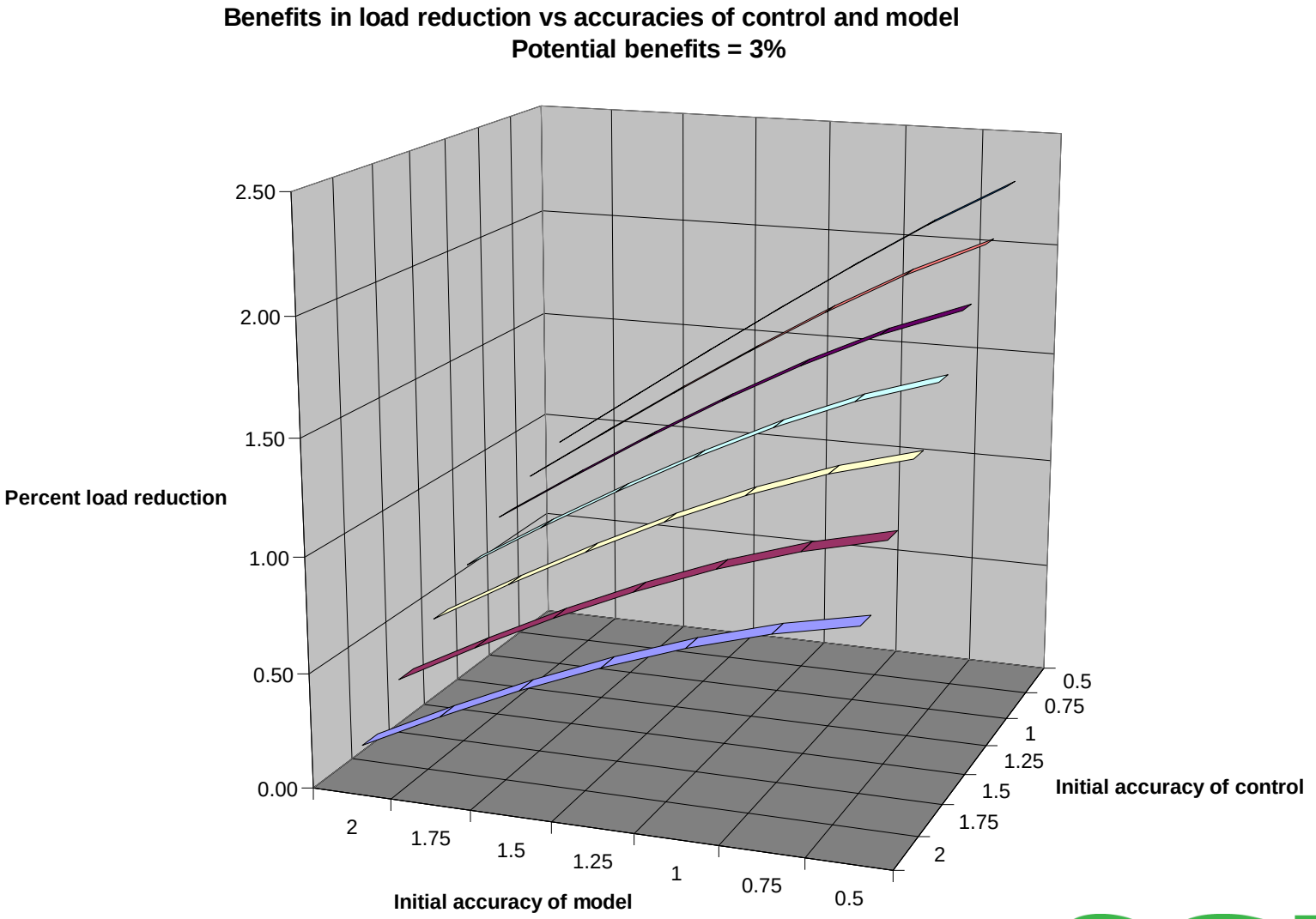
# Example histogram of voltage modeling error mostly due to the error in LV equivalent



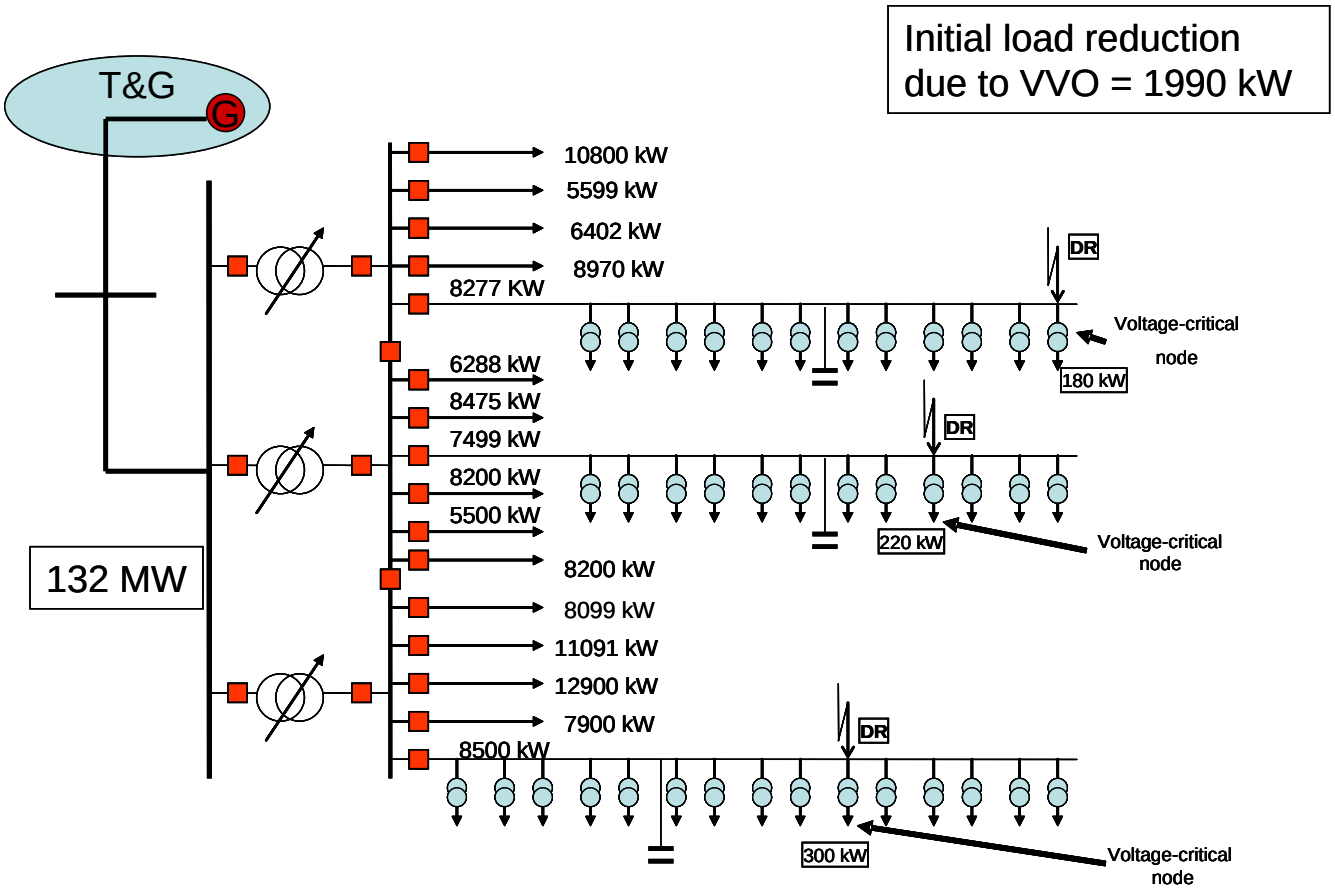
# IMPACT OF MODEL UNCERTAINTY ON BENEFITS

Examples

# Load Reduction due to IVVO

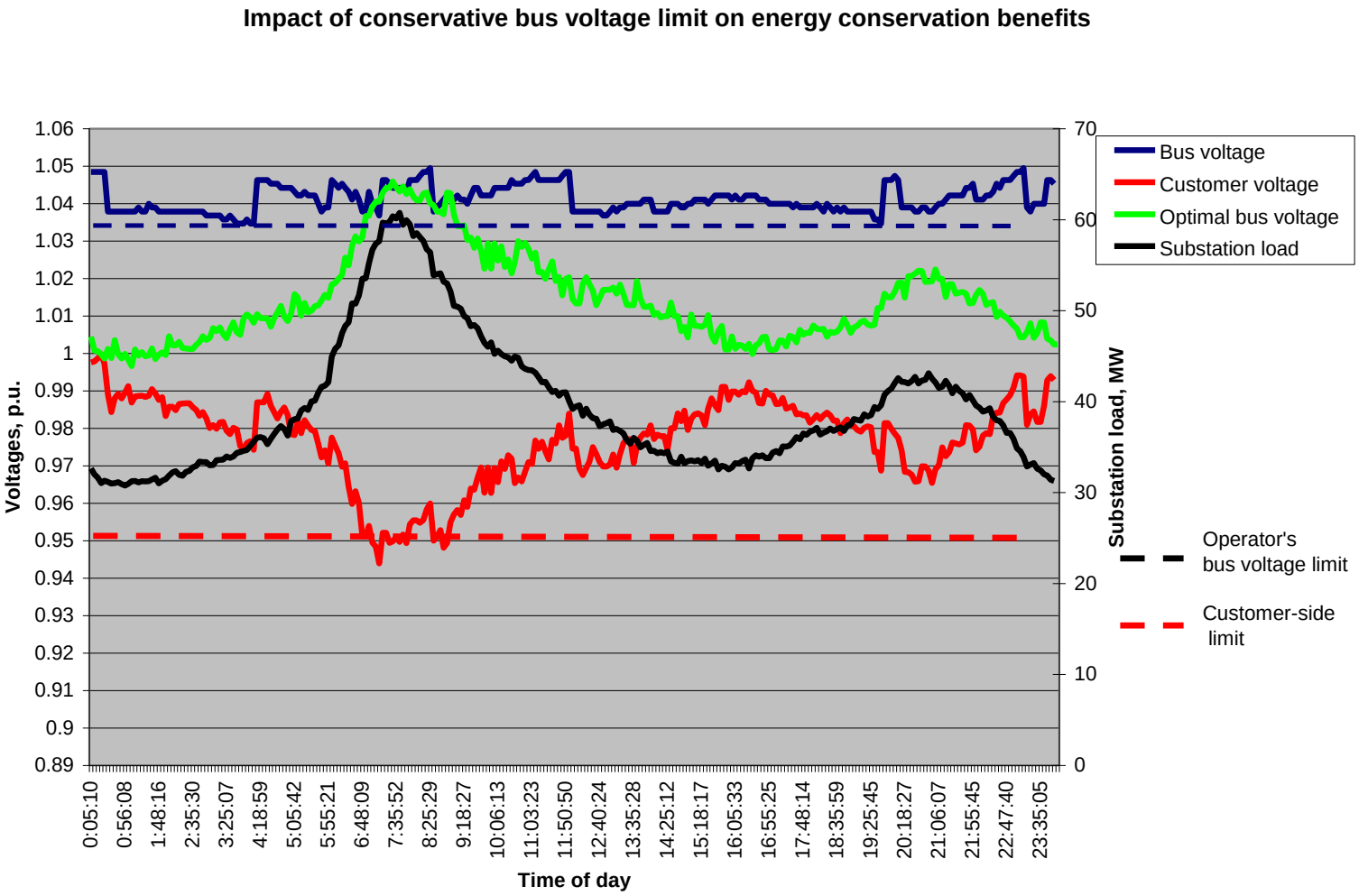


# Benefits of accurately determined voltage–critical nodes with DR

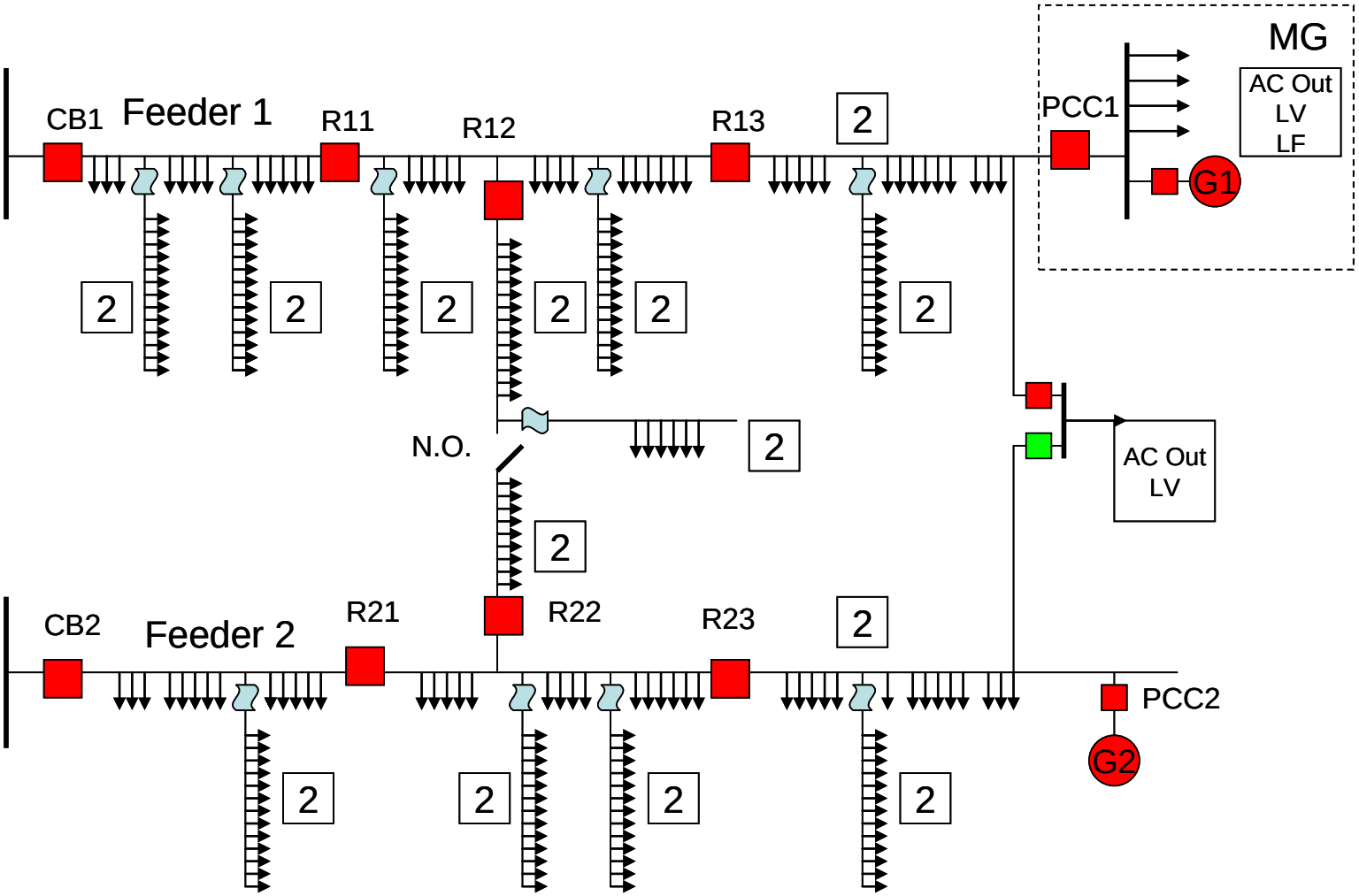



**Total DR = 67 kW; Additional Load Reduction by VVO = 614 kW; Ratio = 9.2; 30% increase of load reduction by VVO**

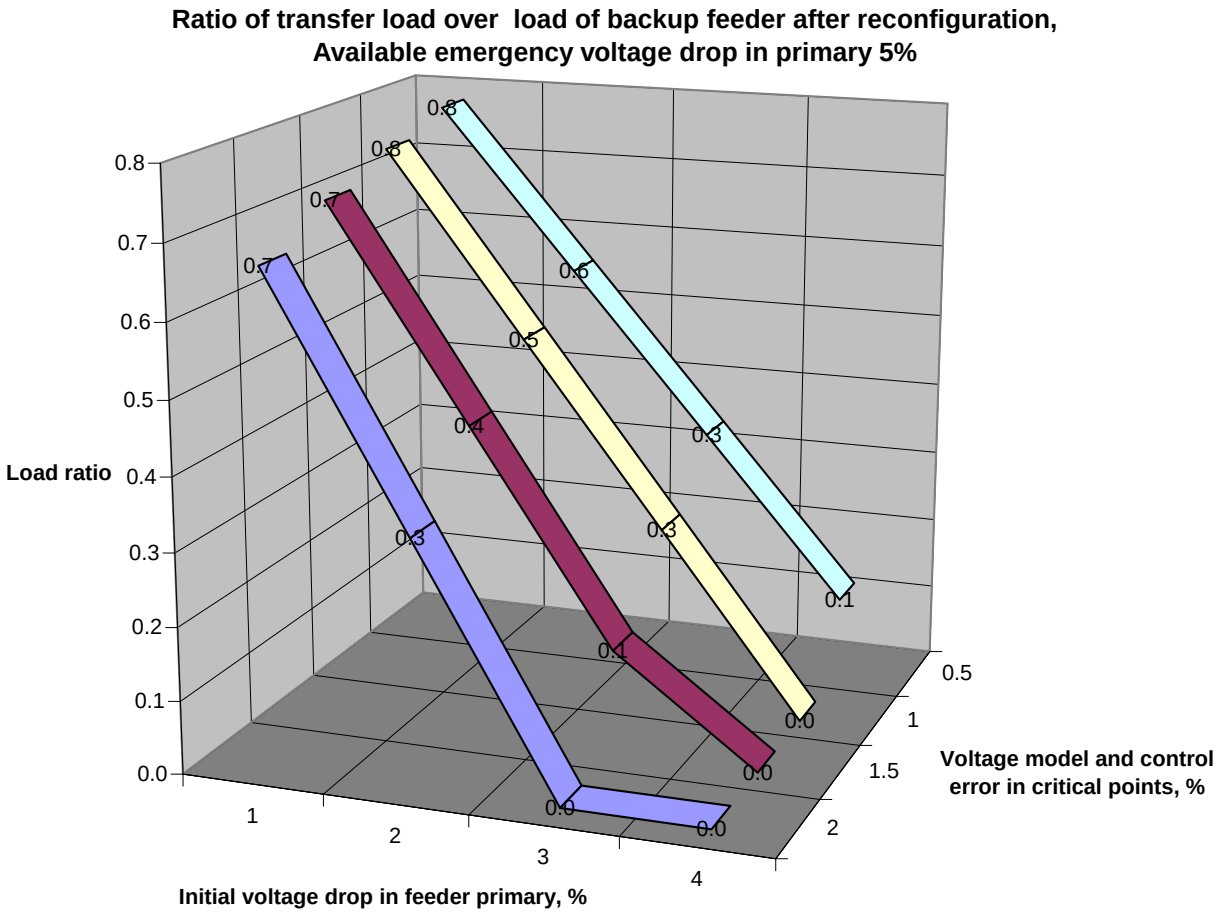
# Lost benefits due to lack of confidence in secondary voltage models



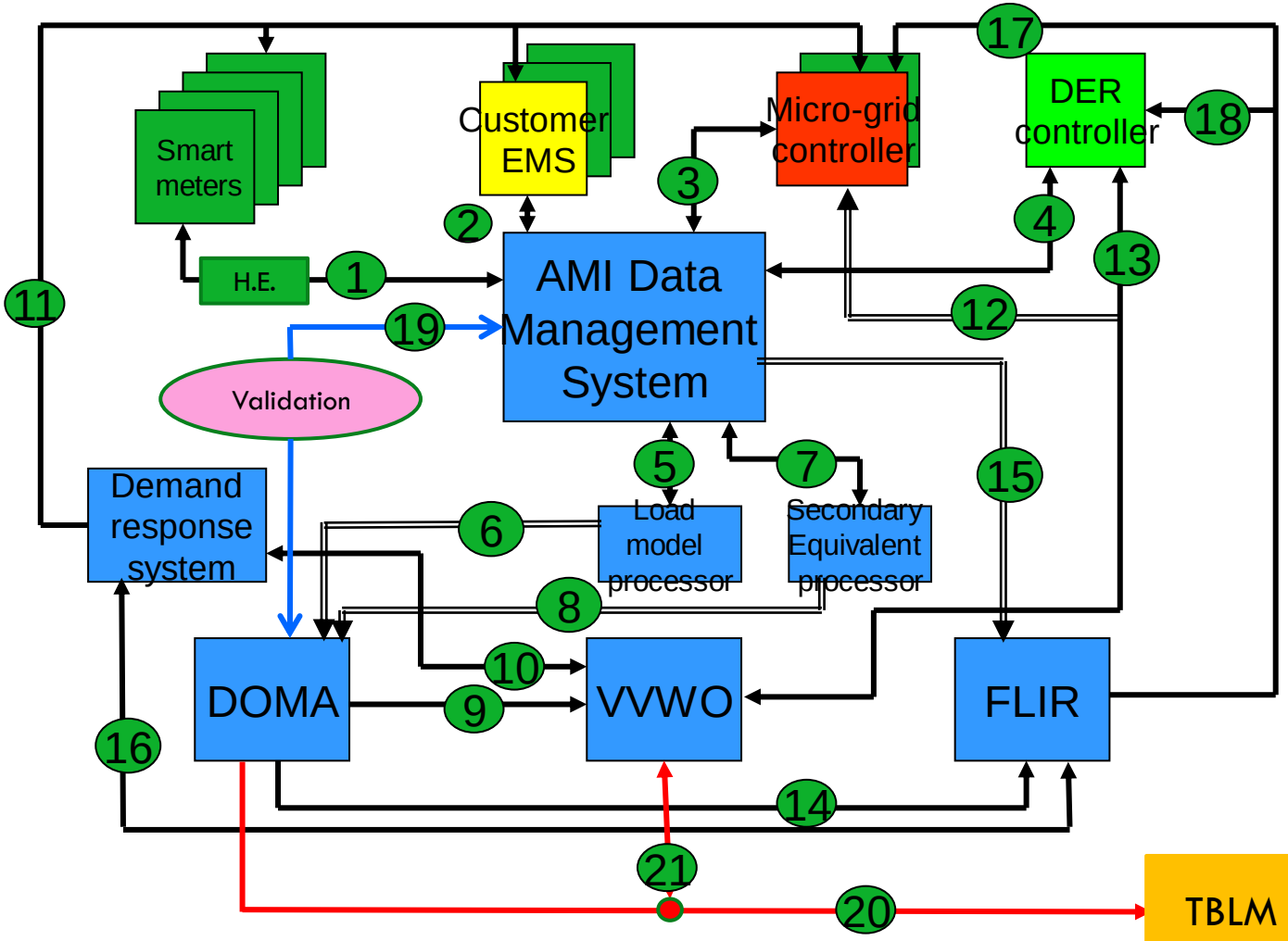
# FLIR Benefits due to AMI
# (fault detection by bellwether meters)



# Impact of model errors on models of transfer capacity limited by voltage (5% limit)



# Interfaces between major actors involved in ADA



# Conclusions

- Customer-site supported data and control capabilities may provide significant added benefits of advanced DA applications.
- The extent of the added values due to involvement of customer-site information support of TnD depends on
  - the design of the DMS/EMS applications,
  - the contents of data gathered from the customer sites,
  - the accuracy of information support by all information sources
  - the accuracy of control actions.
- Most of the information support needed by DMS from the customer systems does not require direct information exchange between the DMS applications and Smart Meters in near real time.
- Advanced procedures for creating adequate adaptive and predictive models should be developed.
- To develop these models, combinations of customer-site data with data obtained from other information systems are needed.

# Thank you!

Questions, Comments?